INSTRUCTION MANUAL
FOR
2020 PRESET COUNTER

TF 711

FREED TRANSFORMER CO., INC.
1718 WEIRFIELD ST.
BROOKLYN 27, N.Y.

INSTRUCTION MANUAL

INSTR.
LAB

FREED TRANSFORMER CO., INC.
1718 WEIRFIELD ST., BROOKLYN (RIDGEWOOD) 27, N. Y.

MP MASTER
MA34267

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FREED TYPE 2020 ELECTRONIC COUNTERS

THE FREED TYPE 2020 ELECTRONIC COUNTERS ARE SINGLE PRESET COUNTERS USED FOR CONTROLLING CONVEYER BELTS, SCREW MACHINES, WINDING MACHINES AND OTHER AUTOMATIC PROCESSES.

THESE COUNTERS ARE ACCURATE, RELIABLE, COMPACT AND VERSATILE. THE COUNTING PULSE MAY BE OBTAINED FROM A MICRO-SWITCH, A RELAY CONTACT OR A PHOTOCELL. THE TYPE 2020-P IS SPECIFICALLY DESIGNED TO BE USED WITH A PHOTOTUBE AND SUPPLIES ALL REQUIRED VOLTAGES TO THE PHOTOTUBE. THIS 2020-P HAS A GREATER INPUT SENSITIVETY THAN THE 2020. THIS IS ACHIEVED BY ADDING 2 STAGES OF VACUUM TUBE AMPLIFICATION AHEAD OF THE 5823 TRIGGER TUBE. THESE ARE THE ONLY VACUUM TUBES USED SINCE THE 2020 M CONSISTS ENTIRELY OF COLD CATHODE TUBES.

THE INSTRUMENT CONSISTS OF A DRIVER TRIGGER AND COLD CATHODE COUNTER TUBE FOR EACH DIGIT, A COINCIDENCE CIRCUIT, A RESET CIRCUIT EITHER MANUAL OR AUTOMATIC, A LOAD RELAY AND REGULATED POWER SUPPLY.

OPERATING INSTRUCTIONS

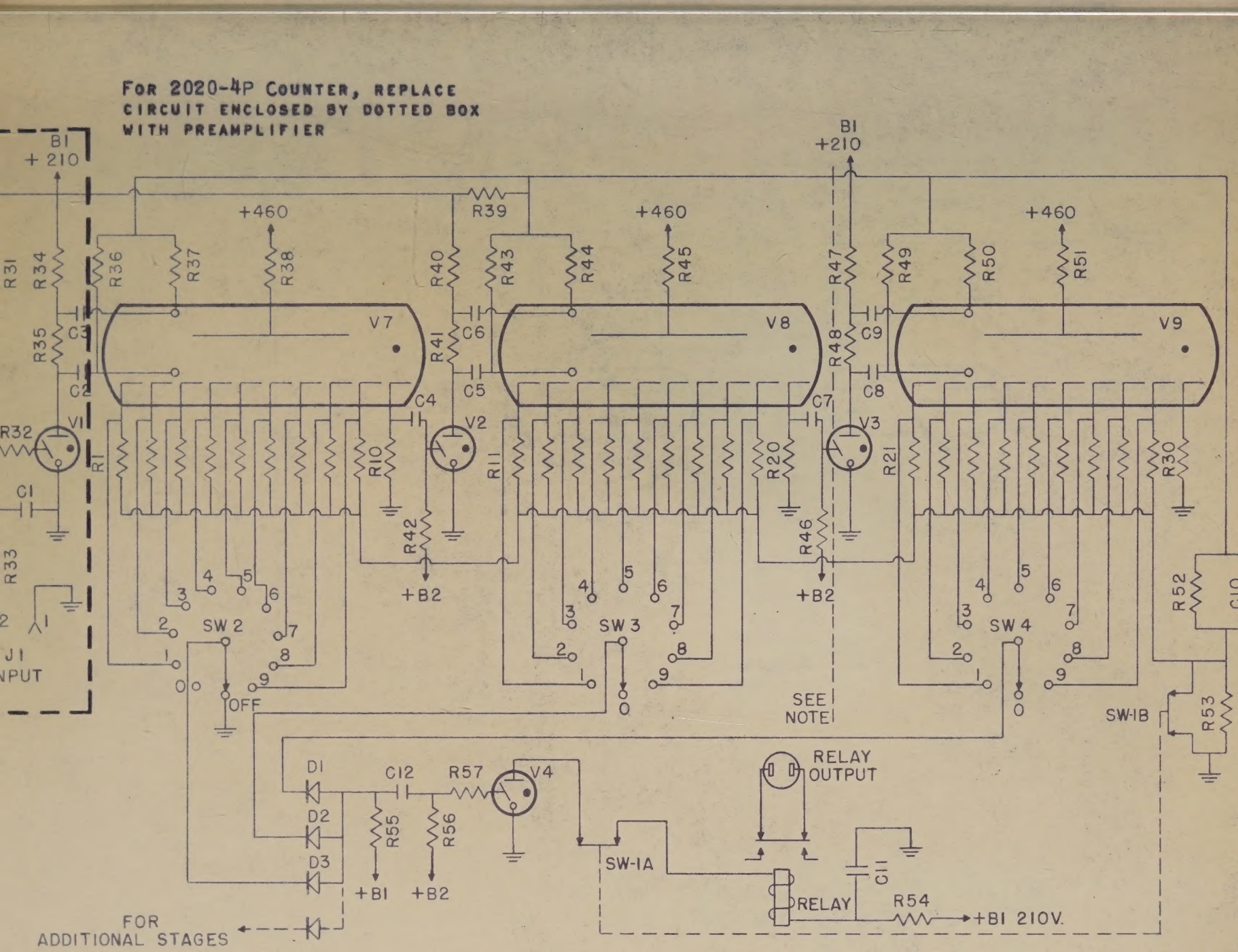
CONNECT THE INSTRUMENT TO 115 VOLT 60 CYCLE LINE. CONNECT THE MICROSWITCH OR DEVICE SUPPLYING COUNT THROUGH AMPHENOL CONNECTOR AT REAR OF CHASSIS. A COUNT WILL BE REGISTERED EACH TIME THIS CIRCUIT IS SHORTED OR OPENED. THE DEVICE THAT IS TO BE CONTROLLED (MOTOR, SOLENOID ETC.) MAY BE CONNECTED TO THE FEMALE RECEPTACLE AT REAR OF CHASSIS. AS LONG AS THE CURRENT LOAD DOES NOT EXCEED 5 AMPERES. THE LOAD RELAY MAY BE CONNECTED TO OPEN OR CLOSE THIS CIRCUIT AS REQUIRED BY SIMPLY CHANGING ONE WIRE ON RELAY. UNLESS OTHERWISE SPECIFIED ALL INSTRUMENTS ARE SHIPPED WITH RELAY CONNECTED TO OPEN CIRCUIT WHEN PRESET COUNT IS REACHED.

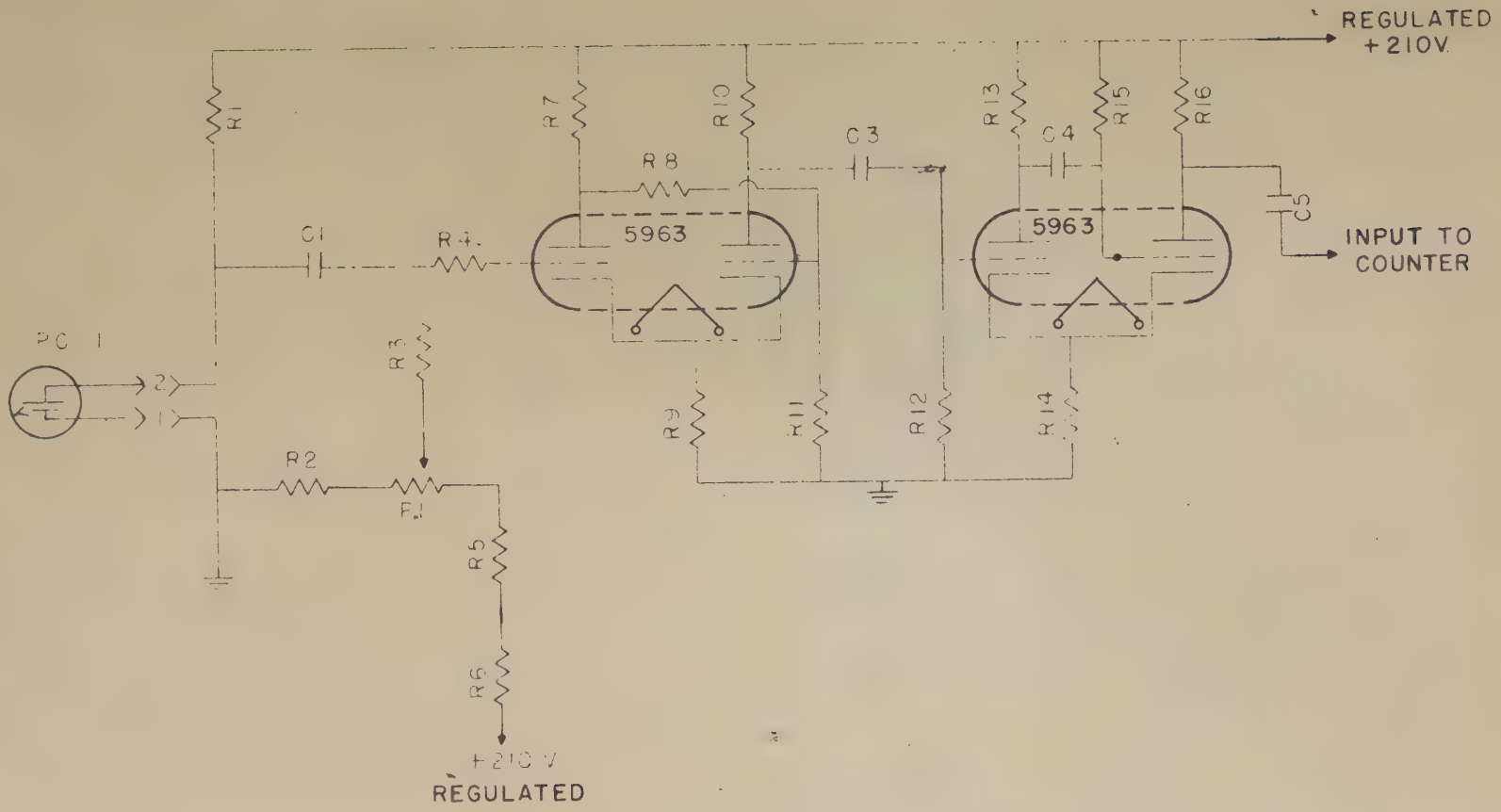
TO OPERATE TURN POWER SWITCH ON AND SET PRESET KNOBS TO DESIRED COUNT. FOR STRAIGHT COUNTING SET RESET KNOB TO OFF. NOW PRESS RESET BUTTON AND THEN START OPERATION. NOTE: FOR COUNTING VERY SMALL QUANTITIES ALLOW 10 SECONDS AFTER RESETTING BEFORE STARTING OPERATION SINCE IT TAKES THIS LONG FOR PRESET TO BE READY TO FUNCTION. THIS MAY BE DISREGARDED IF OPERATING TIME OF COUNTER EXCEEDS 10 SECONDS.

WHEN PRESET COUNT IS REACHED THE RELAY WILL OPEN OR CLOSE CIRCUIT AND BY PRESSING RESET BUTTON THE COUNTER IS READY TO REPEAT THIS OPERATION.

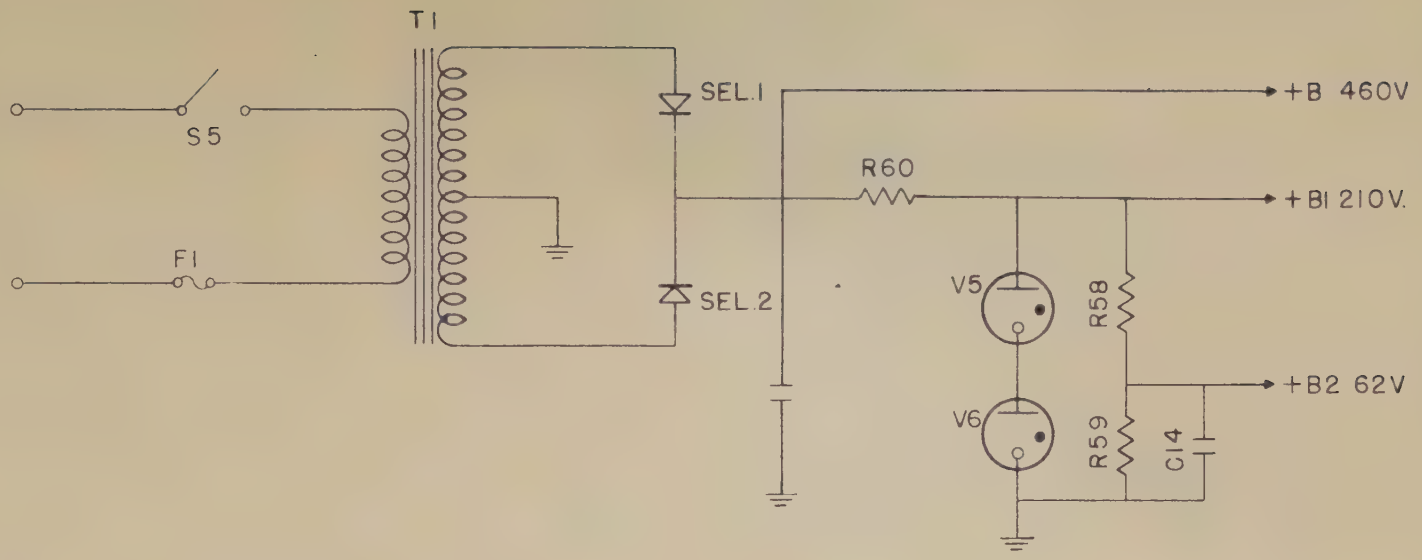
MODEL 2020-P

FOLLOW SAME PROCEDURE AS OUTLINED ABOVE EXCEPT THAT THE FOLLOWING CAUTIONS MUST BE OBSERVED. CONNECT PHOTO-CELL TO AMPHENOL CONNECTOR AT REAR OR CHASSIS REMEMBERING THAT B+ IS BROUGHT OUT. CONNECT PHOTOCELL TO GIVE A POSITIVE INPUT PULSE TO COUNTER. LET MACHINE RUN AT ITS MAXIMUM SPEED AND ADJUST SENSITIVETY CONTROL AT REAR OF CHASSIS FOR SMOOTH COUNTING. THIS SENSITIVETY IS ONLY ON 2020-P MODELS.


FOR 2020-4P COUNTER, REPLACE
CIRCUIT ENCLOSED BY DOTTED BOX
WITH PREAMPLIFIER
B1
+210
+460
R39
R31
R34
R36
R37
R38
R40
R43
R44
R45
R47
R49
R50
R51
R35
C3
C2
C6
C5
C9
C8
V7
V8
V9
R41
R48
C4
C7
V1
V2
V3
R32
R1
C1
R10
R11
R20
R21
R30
R42
R46
+B2
R33
J1
INPUT
SW 2
SW 3
SW 4
OFF
SEE
NOTE
SW-1B
R52
R53
D1
D2
D3
C12
R57
V4
R55
R56
+B1
SW-1A
RELAY
OUTPUT
C11
RELAY
R54
+B1 210V.
FOR
ADDITIONAL STAGES



PRE AMPLIFIER FOR 2020-4P COUNTER
(SEE PRE-AMPLIFIER PARTS LIST)



POWER SUPPLY FOR 2020 COUNTER

PARTS LIST FOR 2020 COUNTER

RESISTORS

R-1 TO R-30	150K OHMS	1/2 W	± 10%
R-31 R-38 R-45 R-51	560K OHMS	1/2 W	± 10%
R-32	2.7K OHMS	1/2 W	± 10%
R-33	100K OHMS	1/2 W	± 10%
R-34 R-40 R-42 R-46 R-47	1 MEG	1/2 W	± 10%
R-35 R-41 R-48	150K OHMS	1/2 W	± 10%
R-36 R-37 R-43	330K OHMS	1/2 W	± 10%
R-44 R-49 R-50	330K OHMS	1/2 W	± 10%
R-39	270K OHMS	1/2 W	± 10%
R-52 R-59	33K OHMS	1/2 W	± 10%
R-53	220K OHMS	1/2 W	± 10%
R-54	39K OHMS	1/2 W	± 10%
R-55	4.7 MEG	1/2 W	± 10%
R-56	10: MEG	1/2 W	± 10%
R-57	2.2K OHMS	1/2 W	± 10%
R-58	68.K OHMS	1/2 W	± 10%
R-60	8K OHMS	10 W	± 10%

CAPACITORS

C-1	2500 MMFD.	± 5%	MICA	500V
C-2 C-5 C-8	330 MMFD.	± 5%	MICA	500V
C-3 C-6 C-9	1000 MMFD.	± 5%	MICA	500V
C-4 C-7	2000 MMFD.	± 5%	MICA	500V
C-10	1 MFD.	± 20%	PAPER	200V
C-11	10 MFD.	ELECTROLYTIC		500V
C-12	.01 MFD.	± 10%	PAPER	200V
C-13	20 MFD.	ELECTROLYTIC		500V
C-14	1 MFD.	± 10%	PAPER	200V

F-1	FUSE	TYPE 3AG	1 AMPERE
J-1	CONNECTOR	AMPHENOL	No.80-PC2F
SW1A-SW1B	SWITCH, RESET	SWITCHCRAFT	No.1005
SW-2	SWITCH, PRESET	FREED	No.2020-A
SW-3	SWITCH, PRESET	FREED	No.2020-B
SW-4	SWITCH, PRESET	FREED	No.2020-B
SW-5	SWITCH ON-OFF		
RELAY	D.P.D.T.	10,000 OHM COIL	
T.	TRANSFORMER	FREED # 27948	
V-1 V-2 V-3 V-4	TYPE 5823	TRIGGER TUBE	
V-5 V-6	TYPE OB2	VOLTAGE REGULATOR	
V-7 V-8 V-9	TYPE 6476	COUNTER TUBE	
D-1 D-2 D-3	CRYSTAL DIODES	(SPECIAL)	PURCHASE FROM FREED
SEL-1 SEL-2	RECTIFIER	TYPE R50650	

NOTE: ADDITIONAL DIGITS ON THESE COUNTERS REQUIRE THE FOLLOWING COMPONENTS AND ARE PLACED BETWEEN V-8 AND V-9 AS INDICATED BY DOTTED LINE ON SCHEMATIC.

1-V1, 1-R40, 1-R41, 1-C5, 1-R43, 1-R44, 1-R45, 1 EACH R11 TO R20, 1-C7, 1-R46, 1-SW2, 1-V8, AND 1-D1 DIODE.

PREAMPLIFIER PARTS LIST FOR 2020-4P COUNTER

RESISTORS

R-1	1 MEG	1/2 W	± 10%
R-2	33K OHMS	"	"
R-3	470K OHMS	"	"
R-4	10K OHMS	"	"
R-5	6.8K OHMS	"	"
R-6	150K OHMS	"	"
R-7	33K OHMS	"	"
R-8	470K OHMS	"	"
R-9	15K OHMS	"	"
R-10	68K OHMS	"	"
R-11	220K OHMS	"	"
R-12	470K OHMS	"	"
R-13	47K OHMS	"	"
R-14	22K OHMS	"	"
R-15	2 MEG	"	"
R-16	47K OHMS	"	"
R-17	1 MEG	"	"
R-18	1 MEG	"	"
R-19	150K OHMS	"	"

POTENTIOMETER

P-1	20K OHMS

CAPACITORS

C-1	0.5 MFD	± 10%	PAPER	200V.
C-2	1 MFD	± 10%	PAPER	200V.
C-3	220 MMFD	± 5%	MICA	500V.
C-4	2000 MMFD	± 5%	MICA	500V.
C-5	300 MMFD	± 5%	MICA	500V.
C-6	330 MMFD	± 5%	MICA	500V.
C-7	1000 MMFD	± 5%	MICA	500V.

TUBES

V-1	5963	
V-2	5963	
V-3	5823	TRIGGER TUBE

PHOTO CELL

PC-1	CLAIREX CL-2

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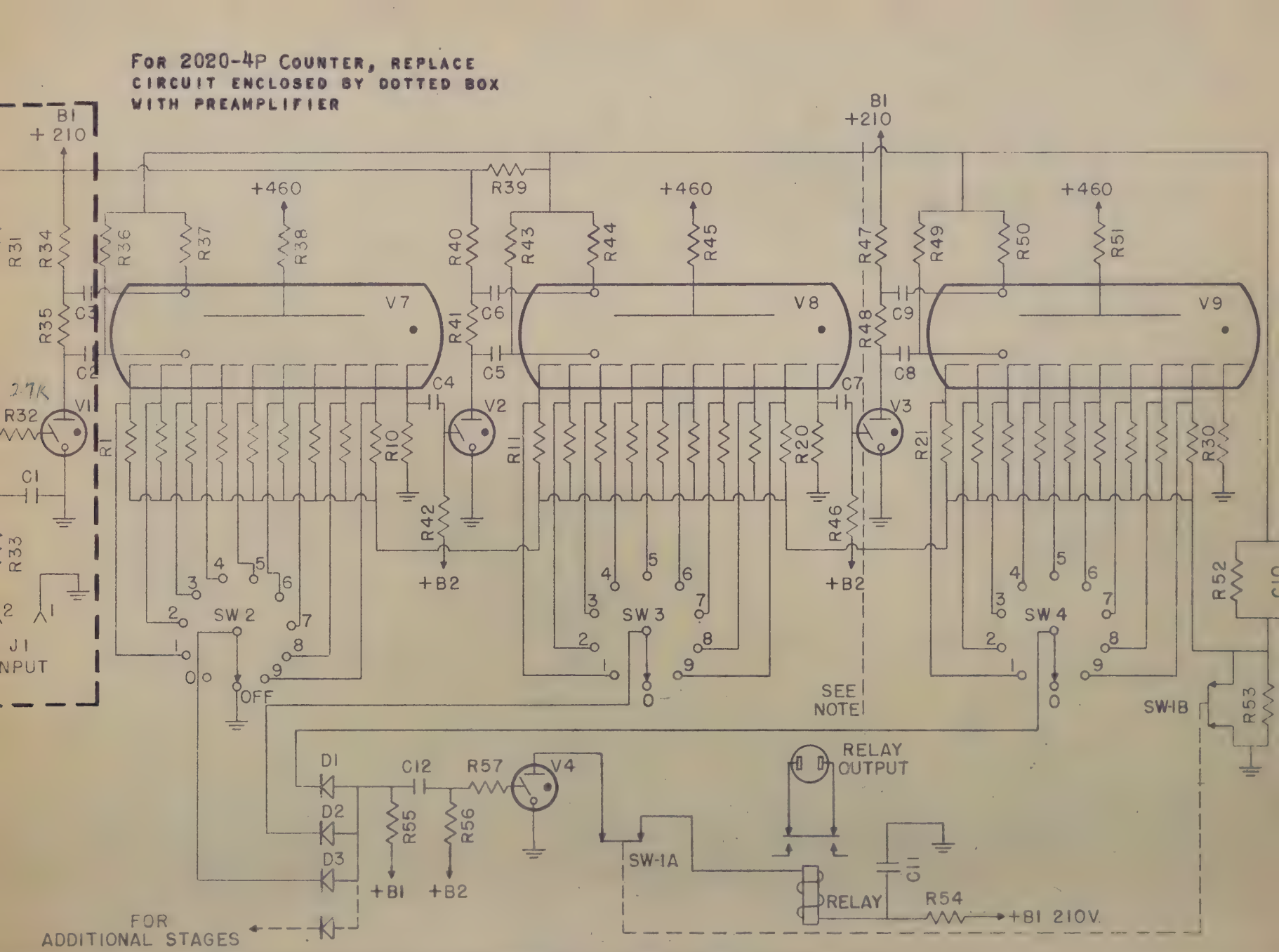

SCHEMATIC FOR 2020 COUNTER

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The two guide cathodes are necessary to make certain that the glow always moves in the desired direction and does not return to the original cathode upon removal of the voltage from the new cathode. A description of the transfer mechanism from one main cathode to the next adjacent one will make this clearer. Assuming that a glow is present on K_1, a negative pulse on the G'_2 will move the glow to G'_2. At the end of this pulse, a second negative pulse is applied to G''_2 moving the glow on to G''_2. Because the guide cathodes are normally biased above the main cathodes, removal of the negative pulse from G" means that the glow will go to a main cathode. The preferential influence of the ionization near K_2 causes the glow to settle on K_2 rather than return to K_1. The glow will remain on K_2 until the sequence is repeated for the next set of cathodes. In practice, all of the G' electrodes are connected together as are also all of the G" electrodes. Although the negative transfer pulse is applied to all ten guide cathodes simultaneously, the priming influence of the discharge moves the glow to the guide cathode which is closest to the discharge.

An output pulse can be obtained from each main cathode as the glow moves onto it. If preferred, an output can be derived from selective cathodes only. It should also be noted that reversal of the pulse sequence applied to G' and G" will reverse the direction of the glow transfer.

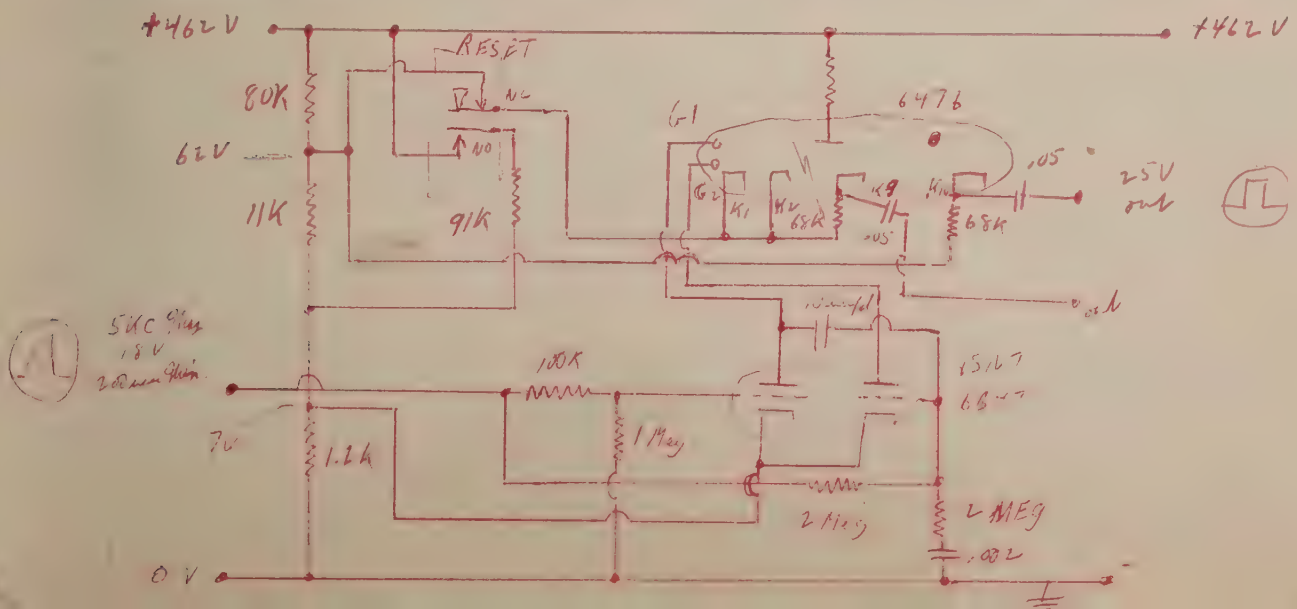
The glow is restricted to one main cathode only when the anode voltage is first applied by the action of the anode resistor which immediately lowers the voltage across the anode-cathode gap to the maintaining value. This is below the starting voltage of the other main cathodes or the transfer voltage of the guide cathodes.

The driving circuit given below offers certain advantages over the previously published circuits.

TYPICAL DRIVING CIRCUIT

The important feature of the new circuit is that it provides an essentially square wave pulse to the guide pins. A square wave driving pulse assures stable operation throughout the life of the 6476 in spite of small changes which may occur in the guide voltages.

NOTE: The B+ of the driver is obtained through the guide to anode capacity of the counter tube.



MECHANICAL DATA

Mounting Position	Any (Count is Read from Top of Tube
Zero Position (Cathode No. 10)	Aligned with Pin 12 ± 10°

ELECTRICAL DATA

RATINGS (Absolute Values)

Total Anode Current	0.60 Ma. Max.
Voltage Between Electrodes (Other Than Anode)	140 Volts Max.
Supply Voltage (Anode to Cathode)	350 Volts Min.
Input Frequency	4,000 P.P.S.Max.

TYPICAL OPERATION

DC Supply Voltage	400 Volts
Anode Resistor	0.47 Megohm
Nominal Tube Drop (Under These Conditions).	191 Volts
Cathode Resistor	68,000 Ohms
Output Voltage (Developed Across Cathode Resistor)	28 Volts

APPLICATION DATA

The Sylvania Type 6476 is a cold cathode, bidirectional decade counter tube. It is designed for use in medium speed decimal counting apparatus such as scalers, computers and dividers. The count is determined by noting the position of the glow on any one of the ten radially spaced cathodes around an axially positioned anode. The multiple output cathode arrangement allows the selection of pre-set conditions with the addition of suitable external circuitry.

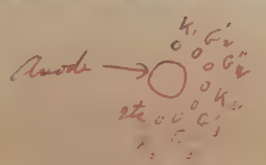
PRINCIPLES OF OPERATION

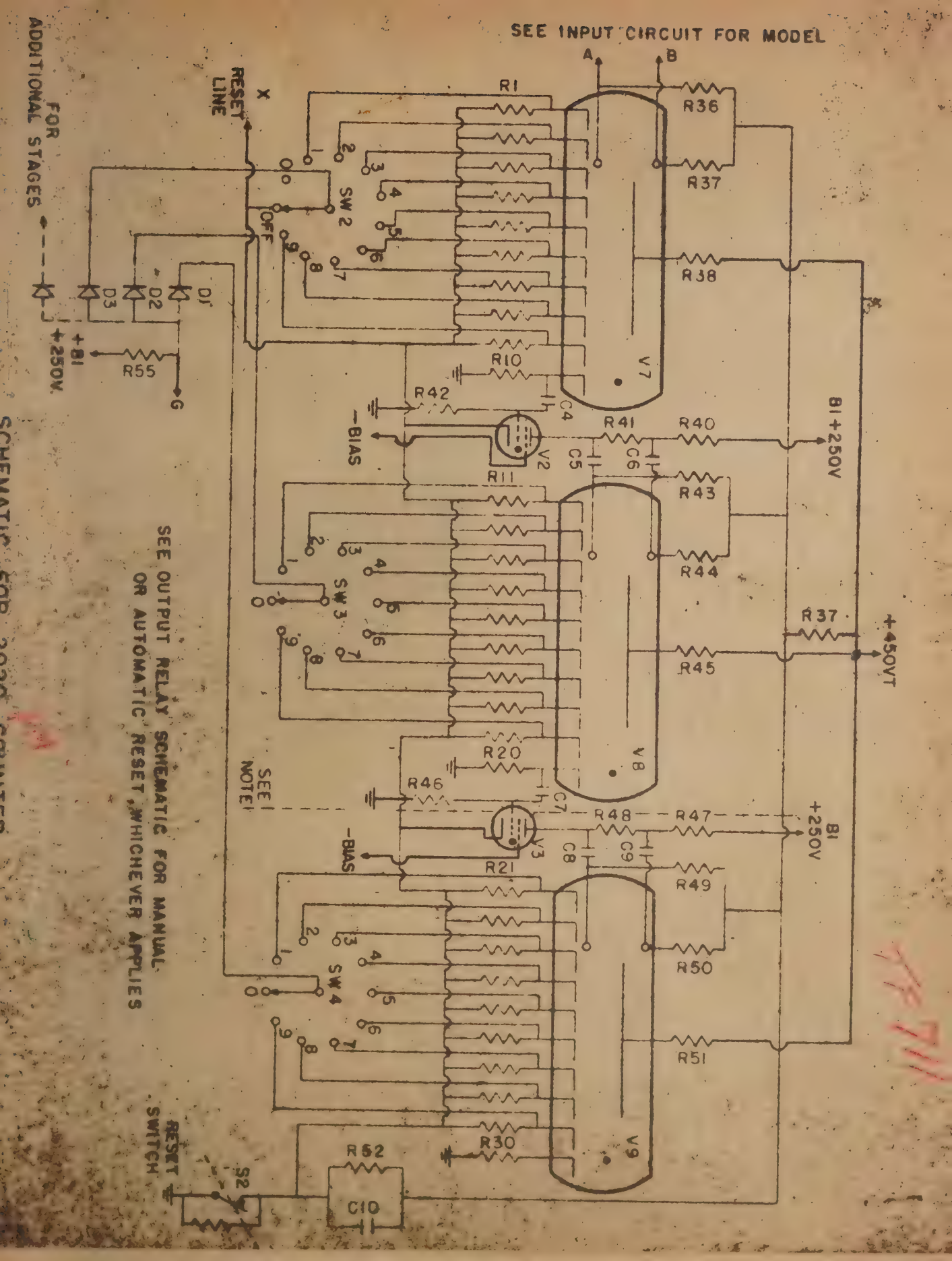
General Principles

The 6476 operates on the principle that the ionization or starting voltage of gas filled tubes is lowered if ions or electrons are already present in the anode-cathode gap. Under these conditions, a glow discharge can then be made to move from one cathode to an adjacent one by means of a relatively small negative voltage pulse on the new cathode, provided that electrons or ions are able to diffuse into this new anode-cathode gap. If a series of cathodes are present about a common anode, the discharge can be made to move in succession along the cathode series by a successive application of voltage pulses to each cathode.

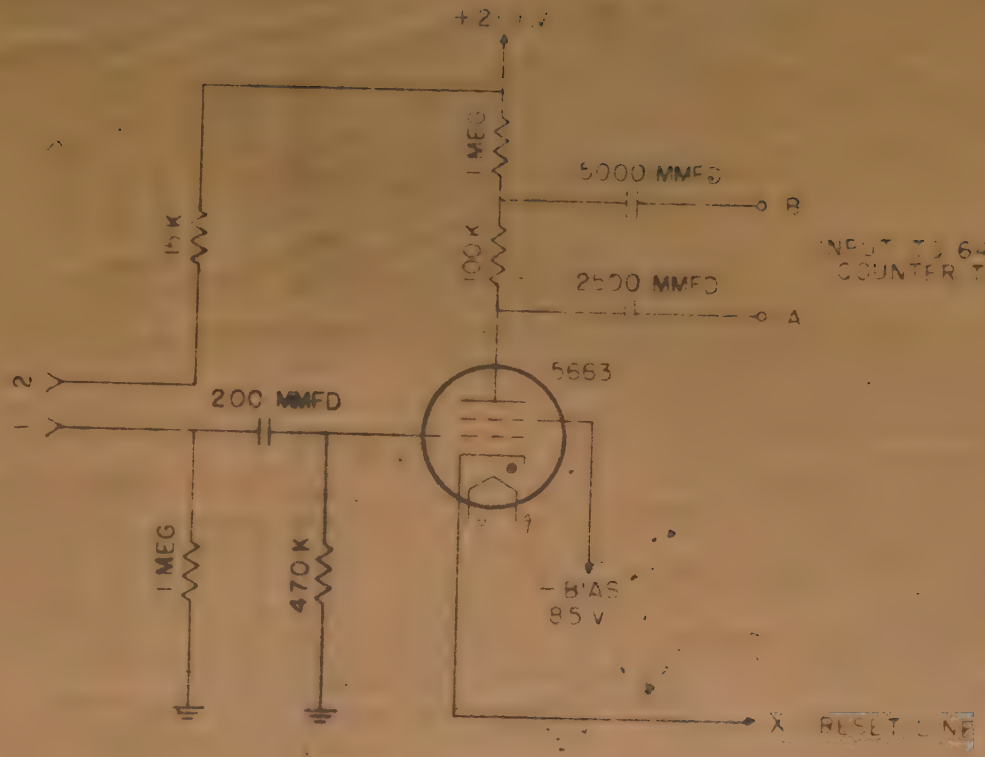
Details of Operation

The 6476 has 30 cathodes equally spaced on a circle about a central anode disc. The cathodes are divided into 10 main or output cathodes and 20 intermediate guide cathodes -- two of which are located between every main cathode interval.

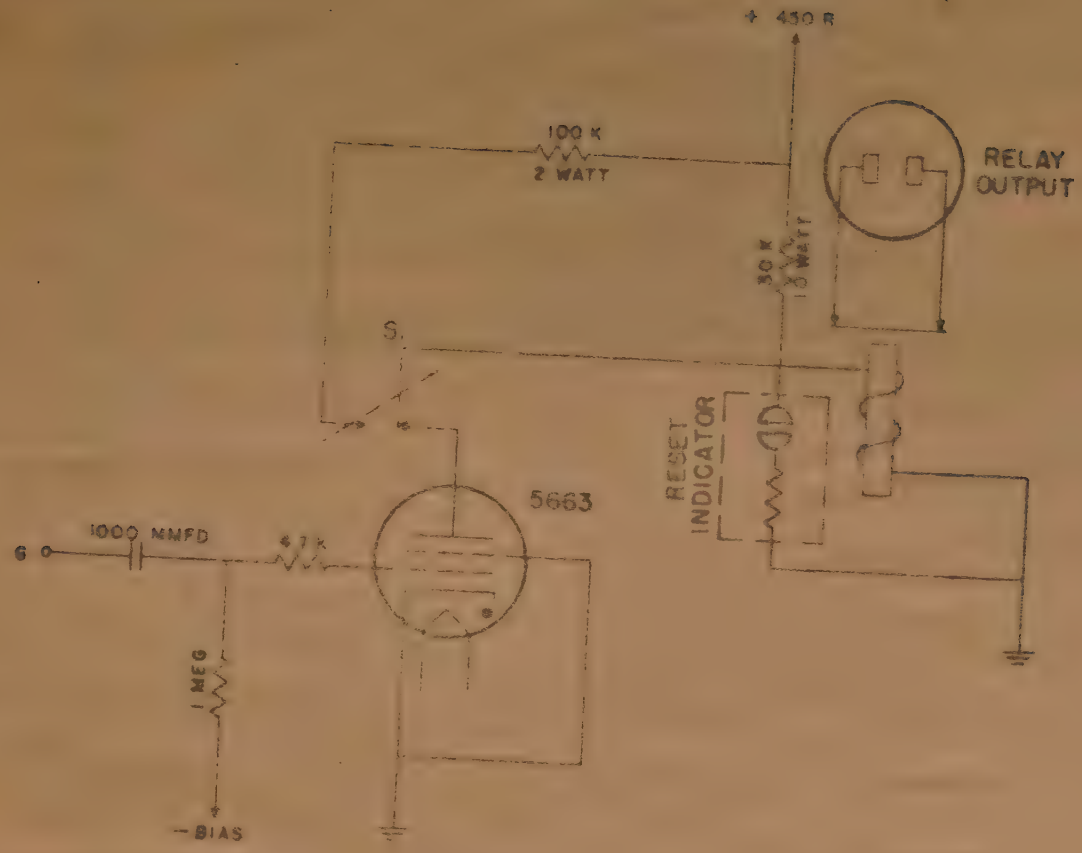



SEE INPUT CIRCUIT FOR MODEL
A
B
R1
R36
R37
R38
RESET LINE
X
SW 2
OFF
D3
D2
D1
+B1
+250V.
R55
G
FOR ADDITIONAL STAGES
R10
V7
R42
C4
-BIAS
V2
R41
R40
C5
C6
B1+250V
R11
R43
R44
SW 3
R37
+450VT
R45
SEE OUTPUT RELAY SCHEMATIC FOR MANUAL OR AUTOMATIC RESET, WHICHEVER APPLIES
R20
V8
SEE NOTE
R46
C7
R48
R47
B1 +250V
-BIAS
V3
C8
C9
R21
R49
SW 4
R50
R51
R52
R30
V9
RESET SWITCH
S2
C10

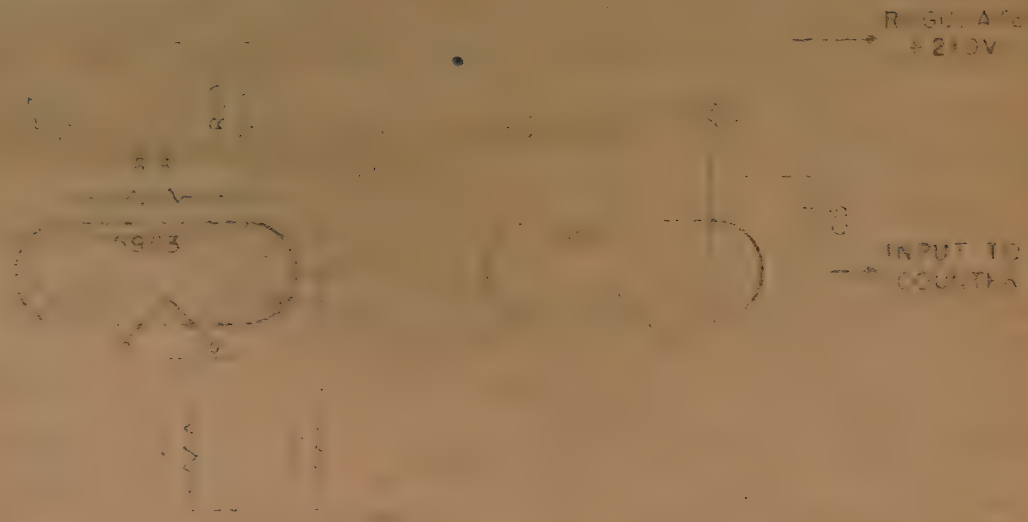
TF 711



INPUT - 2020 - 4P - CLAMP
FAST RESPONSE



1/2 WATT UNLESS NOTED.
OPEN CIRCUIT WHEN PRESET IS READY



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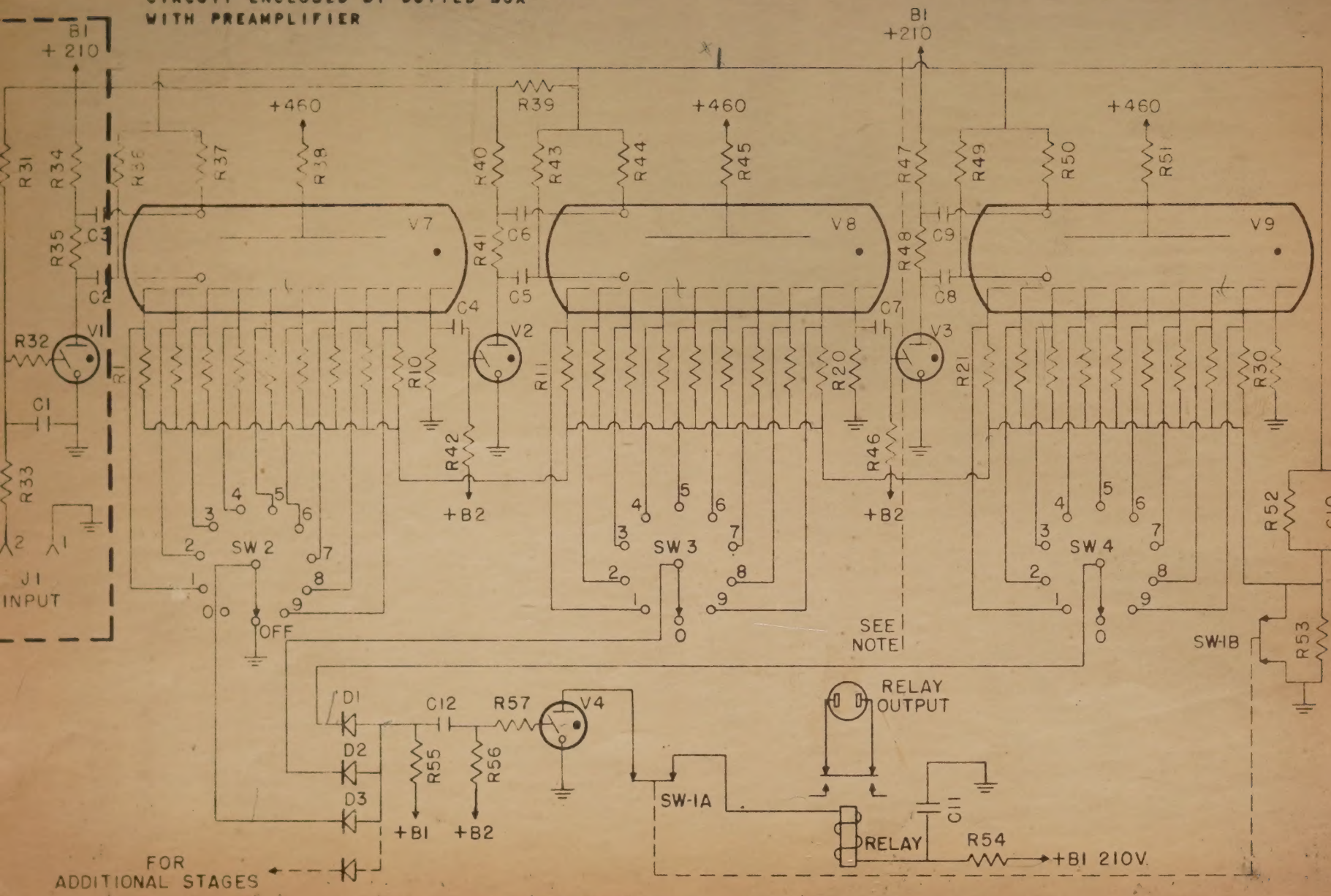
FOR 2020-4P COUNTER, REPLACE CIRCUIT ENCLOSED BY DOTTED BOX WITH PREAMPLIFIER



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